Contribution of land surface evapotranspiration to summer precipitation over the Khentii Mountains, Northern Mongolia

*Fuyuko Sawada[1], Hatsuki Fujinami[2], Tetsuya Hiyama[2]

1. Graduate School of Environmental Studies, Nagoya University, 2. Institute for Space-Earth Environmental Research, Nagoya University

Mongolia is an inland country with a semi-arid climate, where land surfaces strongly influence precipitation. In northern Mongolia, summer (June–August) precipitation accounts for about 60% of the annual precipitation. Although summer precipitation is associated with cyclonic disturbances and land surface processes, quantitative assessments of these processes are limited. This study focuses on precipitation related to land surface processes and investigates their contribution by using MSWEP and ERA5.

We focus on Khentii Mountain (47–51˚N, 106–115˚E) in northern Mongolia, which is one of the highest precipitation regions in Mongolia and shows an afternoon peak in the diurnal cycle of precipitation. During 2014–2023, summer precipitation was the lowest in 2016 and the highest in 2020. Afternoon precipitation during 11:00–20:00 LST accounted for 55% of total summer precipitation in 2016 and 64% in 2020, and the number of days in which afternoon precipitation accounted for more than 50% of daily precipitation (afternoon precipitation day) was 57 days in 2016 and 64 days in 2020. In both 2016 and 2020, afternoon precipitation tended to occur after heavy rain events caused by cyclonic disturbances passing over northern Mongolia. This suggests that surface wetting by precipitation associated with cyclonic disturbances and surface heating after their passage enhanced convective precipitation. Precipitation on days with cyclonic disturbances is mainly caused by moisture flux convergence. In contrast, on days without strong cyclonic disturbances, evapotranspiration from the land surface is expected to play a more vital role in precipitation. We therefore applied the atmospheric water budget to examine the contribution of evapotranspiration to precipitation. As a result, precipitation during heavy rain events was mainly dominated by moisture convergence, whereas evapotranspiration played a large role in light rainfall days. Furthermore, evapotranspiration remained relatively high for several days to one week following heavy rain days and tended to coincide with afternoon precipitation days. The ratio of evapotranspiration to precipitation on afternoon precipitation days was 108% in 2016 and 63% in 2020. On days other than afternoon precipitation days, the ratio was 124% in 2016 and 102% in 2020. These results indicated that evapotranspiration contributed more to precipitation in dry years, such as 2016.

Keywords: Northern Mongolia, Summer precipitation, Evapotranspiration, Moisture flux convergence

